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The Ratio Oribatei: Trombidiformes with Reference to Organic Matter Content in Soils

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Synopsis

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Judging from the numbers of the different groups of mites recovered from soil samples collected in various South African biotopes, soil water content as such is not always the most important factor in determining the composition of the acarofauna. A highly significant correlation value of 0.90 exists between the ratio Oribatei: Trombidiformes, and the percentage of organic matter in different soils. The Oribatei dominate in soils with a high organic matter content whereas the Trombidiformes are more abundant than the Oribatei in soils in which the percentage organic material is relatively low. It is suggested that the small species of Trombidiformes, which form the bulk of this group, might feed on Protozoa and Bacteria which are present in the small pore spaces of the poor soils.

Nach der Anzahl der verschiedenen Gruppen von Milben zu urteilen, die in Bodenproben in verschiedenen südafrikanischen Biotopen gefunden wurden, ist der Wassergehalt als solcher nicht immer der wichtigste Faktor, der die Zusammensetzung der Acarofauna bestimmt. Ein hoch signifikanter Korrelationskoeffizient von 0,90 läßt sich für bestimmte Verhältnisse von Oribatei: Trombidiformes und den Gehalt an organischer Substanz in verschiedenen Böden nachweisen. Die Oribatiden dominieren in Böden mit einem hohen Gehalt an organischer Substanz, währenddessen die Trombidiformes in solchen Böden häufiger als die Oribatiden vorkommen, in denen der Gehalt an organischer Substanz relativ niedrig ist. Es wird vermutet, daß die kleinen Arten der Trombidiformes, die die Hauptmasse dieser Gruppe ausmachen, sich möglicherweise von Protozoen und Bakterien ernähren, die in den kleinen Porenräumen armer Böden leben.

1. Introduction

In the course of investigations on the composition of the mesofauna in South African soils undertaken during recent years it was established that the trombidiform mites tend to be the numerically dominant group in both cultivated and uncultivated soils of the relatively dry steppe and savannah regions. Further investigations, however, indicate that soil water content as such is not the most important factor in determining the composition of the acarofauna since the Oribatei are more abundant in certain biotopes within the same areas. In the present paper an attempt is made to correlate the amount of organic material present in a particular soil with the abundance of either the Oribatei or the Trombidiformes. Of the complex of factors which determines the composition of the soil acarofauna organic matter seems to exert a more direct effect on the nature, distribution and abundance of soil animals.

2. Material and sampling areas

The material on which this investigation is based was collected in a steppe environment with small patches of dry savannah. The different biotopes are all in or in the vicinity of Potchefstroom which is situated on an inland plateau with an altitude varying between 4000 and 5000 ft (ca. 120—150 m). During the year the air temperatures range from a highest ever recorded maximum of 39 °C to a lowest ever minimum of —10 °C. During the period October to March 84 % of the

Table 1 Numbers of Oribatei and Trombidiformes per subsample for Biotopes A—F

	A		B		C		D		E		F	
Subsample No.	Orib.	Tromb.	Orib.	Tromb.	Orib.	Tromb.	Orib.	Tromb.	Orib.	Tromb.	Orib.	Tromb.
1	94	560	16	77	1	7	6	40	183	106	203	181
2	90	552	54	237	0	9	7	12	190	126	391	350
3	126	702	11	214	2	39	15	36	211	114	45	59
4	151	970	45	146	0	27	5	6	229	100	232	120
5	87	690	62	248	1	28	4	9	200	167	61	42
6	182	668	27	142	0	13	7	10	220	163	170	121
7	130	1258	20	82	0	26	6	13	49	109	328	272
8	115	699	10	111	0	4	1	19	34	67	64	92
9	116	933	15	122	0	18	2	16	45	64	55	73
Mean Numbers/m²	38,964	239,621	8,863	47,008	136	5,829	1,840	5,522	46,395	34,634	55,769	44,639

mean annual total of 621 mm rainfall on the average, a distribution which is typical for the summer rainfall area.

Six soil samples (upper 5 cm), each consisting of nine subsamples, were taken during April 1965 in six different biotopes. Sample cores were taken in 6.5 × 5 cm brass cylinders and each was extracted separately by means of a high-gradient extractor. The numbers of Oribatei and Trombidiformes recovered from each subsample are given in Table 1. The percentage organic material was kindly determined in each soil by Fisons laboratories, with the following remarks: "The carbon was determined and converted to percentage organic material using a formule; for this estimation a conversion factor was used."

Sample A (sandy soil) was taken in a small thorn-tree (*Acacia karoo* Hayne) community and B (sandy) in a patch of the indigenous grass, *Themeda triandra* Forsk., both biotopes being situated on the University campus. Sample C (sandy) was recovered from cultivated soil under maize to which organic fertilizer was added two months before the sampling date. The three other samples were taken near the Mooi river; sample D (wet clay-loam soil) on bare ground approximately 1 ft. (0,3 m) from water edge, E (clay-loam with relatively thick litter layer) under a willow tree (*Salix capensis* Thunberg) about 4 ft. (ca. 1,2 m) from water edge, and F (clay-loam) in a poplar tree (*Populus deltoides* Marshall) community about 10 yards (ca. 9 m) from the river.

3. Results

The ratios Oribatei: Trombidiformes as well as the percentages of organic matter in the six samples are given in Table 2. In addition to these results the available data obtained by other South African workers are also given (van den Berg, 1965; Oliver and Ryke, 1966; Loots and Ryke, 1966; Erasmus, 1966; den Heyer and Ryke, 1966). The soil samples investigated by van den Berg were collected from six stations in a subtropical montane forest whereas those of the other authors were taken in the Potchefstroom area. All these investigations were limited to the upper 5 cm layer and the figures used are those which were obtained over a period of a year.

Table 2 Ratio Oribatei: Trombidiformes in relation to soil organic matter content in different South African soils

	Biotope	Ratio $\frac{\text{Oribatei}}{\text{Trombidiformes}}$	% Organic matter
	A. Acacia	0.161	13.7
	B. Themeda	0.185	5.3
	C. Maize	0.023	7.9
	D. River Bank	0.333	6.3
	E. Salix	1.300	36.0
	F. Populus	1.200	39.8
Other authors			
van den Berg	Forest Sta. 1	1.800	79.0
—	Forest Sta. 2	2.000	78.0
—	Forest Sta. 3	2.200	62.0
—	Forest Sta. 4	3.100	66.0
—	Forest Sta. 5	3.000	59.0
—	Forest Sta. 6	1.800	77.0
Olivier and Ryke	Kikuyu	0.714	11.3
Loots and Ryke	Pasture A	0.370	4.0
—	Pasture B	0.182	2.8
den Heyer and Ryke	Acacia	0.192	2.8
Erasmus	Eragrostis	0.007	1.9

A statistical analysis of the figures given in table 2 shows that a highly significant correlation value of 0.90 exists between the ratio Oribatei : Trombidiformes and the percentage of organic matter content whereas the Trombidiformes are more abundant than the Oribatei in soils in which the percentage organic material is relatively low. This correlation does not imply that the Trombidiformes actually occur in higher numbers in biotopes with a relatively low percentage of soil organic matter than in those with a higher percentage. VAN DEN BERG (1965), for example found a maximum of 120,000 Trombidiformes per m^2 in the rich subtropical forest soil as against a maximum of 38,000 per m^2 recorded by LOOTS and RYKE (1966) for pasture soil with a relatively low percentage organic matter; the highest numbers of Oribatei per m^2 for these two biotopes were 205,000 and 23,000 respectively. Both the Oribatei and Trombidiformes are affected by adverse climatic conditions but the latter group can probably resist dry conditions better than the former.

The relatively high numbers of Trombidiformes recovered from the kikuyu, *Themeda*, *Eragrostis*, and *Acacia* soils were largely due to the abundance of small species such as *Tydeus* sp., *Coccotydeus* sp., *Tarsonemus* sp. and *Nanorchestes* sp. In forest soils they are replaced by larger species such as those belonging to the families Eupodidae, Cunaxidae, Bdellidae and Callignollidae, the majority of which probably are predacious.

The fact that the Oribatei in general prefer soils with a high organic content whereas the smaller Trombidiformes can reach high numbers in poor soil is an indication of their food preferences. Since the Oribatei are known to feed on dead organic matter, fungi and algae, their low numbers in the last mentioned soils are understandable. This phenomenon could also be correlated with pore volume and moisture content of the soils. In the soils with a low organic matter content the pore spaces are smaller and not accessible to the larger Oribatei, but the small trombidiform mites might be able to feed on Protozoa and Bacteria inhabiting these minute microhabitats.

HAMMER (1944) attributes the differences between faunas inhabiting wet and dry biotopes to a direct effect of soil moisture. It, however, seems that in some instances wetness or dryness as such indirectly rather than directly exert an influence upon the soil fauna since this factor largely determines the type and density or the vegetation which in turn contributes towards the amount of soil organic matter. The amount and seasonal distribution of the rainfall, therefore, are important factors in determining the soil moisture content, the nature of the vegetation, and the abundance of soil organic matter. The latter not only serves as a source of food but also influences the amount of living space available for the soil animals.

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